

KIPP, (C. J.) *with Dr. Kipp's complement-*

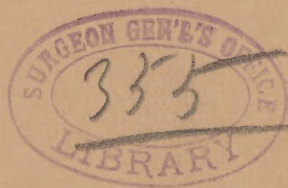
NYSTAGMUS

IN CONNECTION WITH DISEASES OF THE EAR

BY

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THREE CASES OF TRANSIENT BILATERAL HORIZONTAL NYSTAGMUS OCCURRING IN CONNECTION WITH PURULENT INFLAMMA- TION OF THE MIDDLE EAR.

By CHARLES J. KIPP, M. D., Newark, N. J.

Case I.—Chronic purulent inflammation of middle ear, both sides. Acute exacerbation in left ear. Severe pain in mastoid process and head. Intense vertigo. Bilateral horizontal nystagmus lasting four days. Loss of sense of smell. Recovery.

N. E., 28 years of age, was first seen by me Feb. 2. Patient states that his hearing has been poor, and that both ears have discharged from time to time for the last seven or eight years. He has no knowledge of the causes of the otorrhœa. Since three weeks he has intense pain in left ear and in left side of head. Blisters have been applied over the mastoid process and the ears have been syringed by the advice of another physician.

The examination of the left ear shows that the integument of the upper and posterior wall of the external canal, just in front of the drum-membrane, is prolapsed so as to almost close the canal. The drum-membrane cannot be seen. Loud perforation noise on inflation of middle ear on Valsalvian experiment. The skin of mastoid process is excoriated and red, and the lymphatic gland under it is swollen and tender to the touch. Deep pressure in other parts of mastoid process also causes considerable pain.

Only loud speech close to the ear can be heard on either side. (Previous to present attack he heard ordinary con-



versation with the left ear. The right ear has always been very deaf.) The tick of a watch is not heard at all. All tuning-forks (C , C^1 , C^2 , C^3 , C^4) are heard, though indistinctly, through air, and C , C^1 , and C^2 tuning-forks are heard from mastoid process as loud and as long as through air. From vertex only the large prismatic tuning-fork C^3 is heard, but he can not tell with which ear.

The right ear is free from discharge in the external canal. Large dry perforation in drum-membrane. The tuning-forks are heard as in the other ear.

A careful examination of the eyes failed to discover anything abnormal in the movements of the globe or in the appearance of the fundus oculi. Vision was perfect.

In view of the pain in the mastoid I thought it best to make at once a long and deep incision in the prolapsed portion of the external canal. No pus, but a considerable quantity of bloody serous fluid escaped from the incision. He was ordered to syringe the ear with a warm 1% solution of salt, twice daily, and to take 10 grains of sulphate of quinine daily. Morphine was given in sufficient doses to produce sleep. Under this treatment the pain in the ear and head gradually subsided, and the integument of upper posterior wall of the canal slowly resumed its normal position.

On the 12th of February there was a return of the pain in the head and at the same time he became very dizzy. He was obliged to go to bed as he was unable to hold up his head. Next day, February 13, he felt somewhat better and came to see me. On the way he noticed rapid movement of the objects in the street and is positive that the objects moved from left to right before his eyes. In looking at distant objects the vertigo increased in intensity and at the same time he had diplopia. On looking at his eyes I saw at once that both eyeballs were oscillating with great rapidity in the horizontal plane and on closer examination

found that the nystagmus was uninfluenced by the fixation of near or distant objects. No diplopia could be made out. The vertigo was so severe that the patient could hardly stand unsupported. No movements of head similar to those of the eyes were observed. There was no optic neuritis. Scanty otorrhœa. The examination of the ear showed still small calibre of inner end of the external canal. Perforation in drum-membrane not visible, but loud perforation noise on inflation of the Eustachian tubes. Water injected into external canal escaped to great extent into the pharynx. Syringing greatly increased vertigo and sometimes caused a sudden jerk of the head towards the side of the affected ear.

February 15. Vertigo and nystagmus continue. Patient thinks that vertigo is most severe on leaving bed in the morning. Since yesterday has nausea, and often vomits after taking food. Is now free from pain in the ear and head, and sleeps soundly. No change in ear.

February 17. Status idem. Thinks that vertigo is increased by lying on his left side (pressure on the ear?). On examination of eyes with red glass before one, the flame of the candle held in front of him was occasionally seen double, the red image being on the same side as the uncovered eye (crossed diplopia). The distance between the images was apparently the same in all parts of the field of fixation. The nystagmus did not interfere with the movement of the eyeball in any direction.

February 19. Less vertigo. Nystagmus continues.

February 21. Much less vertigo. Nystagmus has disappeared. No diplopia. No headache. No nausea. No vomiting. The external canal is now of normal dimensions throughout. In the anterior half of the drum-membrane is now seen a sharply defined, large perforation of irregular form. Loud perforation noise.

February 28. Is now entirely free from vertigo. Hard

syringing of ear or sudden movement of head, however, still causes momentary dizziness. Ear as last stated. No otorrhœa. No pain on deep pressure to mastoid process. The hearing is no better than it was when he was first seen. The tuning-forks are now heard better and longer from mastoid process than through air.

Since a few days he has entirely lost sense of smell. An examination of the nose failed to discover anything abnormal, except slight catarrh of both sides. Otherwise he is now in excellent health.

March 7. Has now a furuncle on posterior wall of canal, close to meatus.

March 12. Furuncle has disappeared. Patient discharged.

July 1. Learned to-day that sense of smell has been gradually restored. His hearing is now nearly as good as it was before this attack. His health has continued good.

The occurrence of oscillatory movements of the eyeballs as the result of purulent inflammation of the middle ear is doubtless a very rare event. The case here reported is the only one that I have seen in more than twenty thousand cases of ear disease, and a somewhat extended search for similar cases in the literature of eye and ear affections has resulted in my finding the two cases below given in abstract. It is very probable, however, that I have overlooked other cases.

Bürkner (*Archiv für Ohrenheilkunde*, Bd. XIX., p. 249) reports a case of otitis media suppurativa acuta(?) sin., with caries and meningitis, ending in death, in which rapidly oscillating nystagmus was observed nine days before death. Hearing was totally destroyed at the same time, and on the day after the appearance of the nystagmus the left abducens nerve was found to be paralyzed. The autopsy revealed caries of the petrous bone, absence of the ossicles, and total destruction of the inner

ear. An incision into the pons, immediately below the origin of the tri-facial nerve, revealed an abscess of the size of a cherry, from which yellow pus escaped. The wall of the abscess bulged into the fourth ventricle and occupied more than one-half of it. The trunk of the facial and acoustic nerves could not be recognized as such as it was imbedded in a grayish fleshy mass which extended from the posterior margin of the left petrous bone to the medulla oblongata. In the left half of the cerebellum was found a nodule the size of a cherry, composed of a similar grayish mass interspersed with yellowish spots.

Urbantschitsch (*Lehrbuch der Ohrenheilkunde, Zweite Auflage, Wien, 1884, page 306*) reports the case of a girl in whom the entrance of an insect in the ear was followed by purulent inflammation of the middle ear, in the course of which an uncommonly severe bilateral horizontal nystagmus was developed and still persisted ten years after the ear disease had been cured.

In connection with Ménière's group of symptoms, nystagmus has been observed by J. Hughlings Jackson (*Brain, April, 1879*), Jacobson (*Archiv für Ohrenheilkunde, Bd. XXI., p. 293*), and Gruber (*Lehrbuch der Ohrenheilkunde, Zweite Auflage, Wien, 1888, p. 616*).

Moos (*Archives of Otology, Vol. XII, p. 312*) reports a case of mimic facial convulsions complicated with nystagmus and vertigo. Moos thinks that in this case he probably had to deal with a spasm of the stapedius muscle which accompanied the tic convulsif, and was caused by a labyrinthian irritation from diminished tension. The irritation was transmitted on the one hand to the cerebellum; on the other to the centres of innervation of the ocular muscles causing occurrence of the facial convulsions, together with vertigo and nystagmus.

Case II.—Acute purulent inflammation of middle ear, left side. Large deep-seated abscess below apex of mastoid. Intense vertigo. Transient bilateral horizontal nystagmus caused by injection into abscess. Recovery.

C. K., 28 years of age, came to the Newark Charitable Eye and Ear Infirmary, March 24, to obtain relief of intense pain in left ear. According to his statement both ears had been entirely healthy previous to the present attack. On March 12 he had been exposed to the severe snow storm, and in the night following his left ear became painful. On the following day the pain in the ear was intense and extended over the whole left side of the head. In the evening he first noticed a discharge from the ear. Since then the pain and otorrhœa have continued.

At the time he came under observation he looked extremely ill and was evidently suffering very great pain. The examination of the left ear showed the external canal to be full of pus, after the removal of which the walls of the external canal were seen to be swollen and red, the drum-membrane was of livid color and its dermoid layer macerated. In the posterior inferior quadrant was a small perforation, through which on inflation through the catheter at first much thick yellow pus and then air-bubbles escaped. The mastoid process was somewhat tender on deep pressure. With this ear he could hear only loud speech at a distance of a foot. The watch was not heard. Large C² tuning-fork placed on the vertex was heard best in left ear. The tuning-forks were heard when held in front of meatus, but louder and longer from mastoid process. As the opening in the drum-membrane was rather small, I enlarged it. The patient was ordered to syringe his ear with a warm 1% solution of salt several times daily, and as he had not slept for many nights, I gave him morphine at bed-time.

March 25. The pain is as great as yesterday ; the morphine failed to produce sleep. I now applied four leeches in front of the tragus, painted the mastoid process with tincture of iodine, ordered applications of ice to the mastoid, and instillations of a warm 4% solution of cocaine. The morphine to be continued.

March 28. No marked change. Pain and otorrhœa as before. Loud perforation noise on inflation.

April 1. Patient has been more comfortable in the day time since last report, but has still much pain at night. Has night sweats. He feels chilly at times, but has had no rigor. There is some redness and swelling of skin over apex of mastoid, otherwise no change. No optic neuritis.

April 7. Since last report the redness and swelling of the skin over mastoid process have gradually extended downwards for nearly two inches and backwards for about the same distance. The parts underneath are now also much swollen and at a point about one half an inch below and posterior to lowest part of the insertion of the auricle, fluctuation can be indistinctly felt. Otherwise the ear is as before noted. An incision about an inch in length and nearly as deep gave exit to an enormous quantity of healthy yellowish pus. A careful examination with the probe failed to discover rough bone. A large drain-tube was inserted into the opening after the abscess had been washed out with a 1:5000 solution of corrosive sublimate, and a thick layer of iodoform gauze and borated cotton placed over the whole region and secured by a bandage. The syringing of the ear and inflation of the middle ear was continued.

April 17. Since the abscess was opened the patient has been almost free from pain. He is now, however, very dizzy most of the time and his gait is so unsteady that he is ashamed to walk the streets. The otorrhœa ceased almost entirely three days ago. The abscess has been

washed out once daily. There is now but little discharge from it and this is now of glairy consistency and of a light yellowish color. The wound is nearly healed. *Today, while I was injecting the corrosive sublimate solution into the opening with perhaps a little more force than usually, I noticed for the first time that the injected fluid escaped from the external meatus. At the same time the patient jerked his head violently to the left and my colleague, Dr. Rankin, who happened to be looking at the man's face, saw a decided but momentary dilatation of his pupils, which was immediately followed by rapid oscillations of the eye-balls in the horizontal plane.* Although I removed the syringe at once, the oscillations continued for several minutes. The man seemed dazed for a few moments and after he had entirely recovered said that when I injected the fluid a darkness came suddenly before his eyes and he felt as if he were falling to the right. He was extremely dizzy, but did not notice any movement of the objects in the room. An examination of the ear showed that the fluid came through the perforation in the drum-membrane. During the next few days the same train of symptoms was produced every time the injection was repeated, and I had therefore ample opportunity to study the movements of the eyes. The dilatation of the pupil preceded the oscillation of the globes only during the first two days. The eyes moved at first slightly to the left and then more extensively to the right. The movement was equally rapid in both directions and of the same extent in both eyes. The ophthalmoscopic examination failed to discover anything abnormal in either eye.

On April 25 the incision was entirely closed, and the perforation in the drum-membrane had healed. Since then the man has been in excellent health and his hearing was at last accounts nearly as good as before the attack.

Case III.—Acute purulent inflammation of the middle ear. Abscess of mastoid cells. Nystagmus caused by pressure on mastoid process. Recovery.

J. C. V., a healthy looking man, 25 years of age, was first under my care six years ago for an attack of acute inflammation of the middle ear, right side, from which he made a speedy recovery with drum-membrane intact and perfect hearing.

On the 5th of April, 1888, he came to me with another attack of the same disease in the same ear. With this ear he heard the watch only on contact. Tuning-forks placed on vertex were heard best in this ear. Bone conduction better than aerial. He had intense pain in the ear and right side of head and had a very sore throat. The drum-membrane was of a dark red color and bulged outward in its upper posterior quadrant. No air entered the tympanic cavity on inflation of Eustachian tube through catheter. I ordered a gargle of chlorate of potassa for his throat; applied six leeches in front of tragus and under the lobule and advised him to fill the external canal frequently with a warm 2% solution of sulphate of morphine. I also prescribed a brisk cathartic and one-quarter grain of morphine to be taken at bed-time.

April 7. Pain as great as before. No change in appearance of ear. Made a free incision in bulging part of drum-membrane, which evacuated a considerable quantity of pus. Loud perforation noise on inflation by Politzer's method. After thorough cleansing of ear, it was covered with corrosive sublimate gauze and borated cotton and this dressing was secured by a bandage.

April 13. Up to yesterday patient was almost free from pain. The ear has been cleansed by syringing several times daily. Profuse discharge of healthy pus. Loud perforation noise on inflation of middle ear. Today he has again pain in ear and head. With exception of a

slight swelling of lower wall of external canal, near drum-membrane, the ear is in about the same state as at last report. The opening in the drum-membrane is large and patent. No tenderness of mastoid process. Ordered more leeches to ear,—three in front and three behind the ear. Also frequent instillation of warm 5% solution of cocaine. The syringing with warm salt water is to be continued. If unable to sleep he is to take fifteen grains of antipyrin.

April 23. Patient has been quite comfortable for several days past. Last night he had pain in ear and right side of neck, which the antipyrin failed to relieve. There is now a circumscribed swelling on the posterior inferior wall of canal; drum-membrane cannot be seen. Loud perforation noise on inflation. The otorrhœa is less profuse. Made a free incision in the swelling in the canal. No pus escaped from incision. Examination with ophthalmoscope shows normal state of eyes.

May 5. Was summoned to patient's house, and found him in bed but looking tolerably well. Was told by the patient, whom I had not seen for more than a week, that he had been intensely giddy and unable to walk since I last saw him. He had also suffered much from headache and had had several strange "spells," especially at night. His wife said that these "spells" had lasted several minutes and had ended in unconsciousness of several minutes' duration. These "spells" were probably attacks of syncope. The man is still very dizzy today, but has no pain in ear or head. The examination of the ear showed that the swelling in the canal had disappeared. The perforation was no smaller than it was two weeks ago. Otorrhœa as before. Ordered one-quarter grain of calomel with one grain of Dover's powder to be taken every three hours. The ear to be syringed as before.

May 9. Patient called at my office. Vertigo less intense. He is, however, unable to walk without support. No

change in ear. There is now, however, some redness and swelling of skin over the mastoid process. The swelling is greatest about an inch behind insertion of auricle. Pressure on mastoid causes pain. Stopped calomel as gums began to be affected: painted the swollen region with tincture of iodine and ordered ice to same.

May 12. Patient states that the swelling behind ear continued to increase in size up to yesterday. Last night it was so great that he was hardly able to turn his head to the right. Since then it has gone down very much. Today it is less than it was three days ago. The skin over swelling is now of normal color. Pressure on it causes marked pitting, but little pain. Syringing of the ear greatly increased the vertigo this morning, and, on making Valsalva's experiment, the vertigo almost caused him to fall over. The vertigo was also increased by pressure on the swelling over the mastoid process and by pressing the tragus into the external canal. *This last procedure produced also a marked horizontal nystagmus of both eyes.* The nystagmus continued for a few moments after the pressure had been removed. The movement of the eyes was at first to the left and then more rapidly and extensively to the right. When asked how he felt the patient said that his head and body seemed to be spinning around. He did not observe any displacement of objects in the room. On attempting to turn his head suddenly to the right side he fell over on the left. There is now some swelling of upper posterior wall of canal near drum-membrane. Loud perforation noise on inflation. Water injected into external canal escaped in part through Eustachian tube into nose. Tuning-forks placed on vertex are still heard loudest in right ear. Ophthalmoscopic examination negative. Advised Wilde's incision, but this was declined. Continued application of iodine tincture.

May 15. Was called to see patient, whom I found sitting

up and looking much better. He said that he was again very dizzy and unable to walk about. He had no pain in ear, but during the past night he had had much pain in head and something like an epileptic fit. He thought that he was about to die. He seems to have been unconscious for some minutes. The swelling behind the ear is no greater than it was some days ago. The skin over it is not red. *Pressure on swelling now causes pus to flow from external meatus and at the same time greatly increases the vertigo and produces horizontal nystagmus of both eyes which continues for a minute or two after the pressure is removed.* The oscillations of the eyes are of precisely the same character as those previously produced by pressing the tragus into the external meatus, and the nystagmus can now be produced at will by either making pressure on the mastoid process or by pressing the tragus into the external canal; a very careful examination of external canal failed to discover a fistula in the walls of same.

May 18. Patient had another convulsion last night and has now given his consent to the operation. Under ether, I opened the mastoid process according to Schwartze's method, and after removal of outer cortex found a large cavity filled with pus and granulations. The granulations were removed with sharp spoon and communication established between outer opening and antrum. No pus was found between skin and outer cortex of process.

July 15. Patient has entirely recovered his health. He had a slight convulsion of some kind during the night of June 6, but since then he has been free from pain in ear and head. There has been no return of vertigo and his gait is perfectly steady. He sleeps well and attends to his business. The fistula behind the ear is healed, and the perforation in the drum-membrane closed six weeks ago. The hearing of the right ear is fair and is steadily improving. No attempt was made to produce the nystagmus

immediately after the operation, but some weeks later neither pressure on process or the pressing of the tragus in the canal produced it.

Instances in which nystagmus could be produced in the same way under similar conditions have been observed also by Schwabach and J. Hughlings Jackson, and Bürkner.

Schwabach's communication which was published in the *Deutsche Zeitschrift für practische Medicin*, 1878, No. 1, I have been unable to read in the original, and am therefore obliged to rely for the correctness of the facts below stated upon an abstract of the paper in the *Monatschrift für Ohrenheilkunde*, 1878, No. 7, page 92. The patient was a man 41 years of age. Discharge from left ear since infancy. Two weeks ago he had severe pain in the ear. Otorrhœa profuse. Hearing greatly impaired. Skin over mastoid process swollen. Pressure on this part causes severe pain. Of the drum-membrane only a narrow rim remains; ossicles not visible. Intense vertigo, which was increased and accompanied by peculiar movements of the eyes such as he had not before observed, when patient pressed on diseased ear. The supra- and retro-auricular regions were greatly swollen. When Dr. Schwabach pressed on these parts, a considerable quantity of thick pus poured from the external meatus; pain was not caused by pressure, *but the moment pressure was made on the mastoid process close to the insertion of the auricle, on a line with the upper wall of the external canal, and also at a corresponding point of the auricle itself, distinct oscillatory movements of the eyeballs were observed. The oscillations were in a horizontal plane to the left (diseased) side and a little downwards. The oscillations ceased the instant pressure was relaxed.* Syringing of the ear produced oscillations less marked. The oscillations were accompanied by vertigo. Alterations in the size of the pupils were not observed. The oscillations ceased with the im-

provement of the ear disease. Schwabach thinks that he can explain the spasmodic movements of the eye-balls by assuming that the pressure exerted on the ear caused an irritation of the semi-circular canals. (See Cyon's experiments at the end of this paper.)

J. Hughlings Jackson's case is published in *The Transactions of the Ophthalmological Society of the United Kingdom, Vol. III., London, 1883, page 201.*

A woman, *æt.* 49, consulted Dr. Jackson, Nov. 23d. 1882, for giddiness and irregular walking; these symptoms had existed for about three months. She had had disease of the right ear since childhood; at no time had she had noise in it. She had had severe bilious attacks, clearly, by her account, paroxysms of auditory vertigo. There was also a chronic condition, since the so-called bilious attacks she often walked as if drunk. She would sometimes when washing the right ear stumble to the left. She said that pressing on a certain part of the ear (the tragus) made her giddy and produced a disagreeable feeling in her head, "something coming over the brain." *When Dr. Jackson pressed on the tragus he saw her eyes move from side to side,* and she told him that objects "went" from right to left; she did not see them coming back again. She also felt a falling towards the left side. On stopping the pressure the eyes were again still. He could make them move whenever he liked. Mr. Couper saw the case in January, 1883, and found that the jerks were always horizontal towards her right, and equal as well as simultaneously in both eyes. Generally the sharp jerk to the right was preceded by a slower preliminary movement to the left. Movements of widest excursion were obtained when she fixed a distant object above the level of her head. The jerks were shorter when she looked horizontally in front of her, and shortest of all when the axes converged as she looked down at a near object below the level of her

head, and in this last position some rotatory movements were observed. No spasmodic or other abnormal movements of her pupils were detected. Normal acuteness of vision. Dr. Purves examined the ear and found the canal full of pus. There was a swelling on the upper wall of the meatus caused almost certainly by some osseous affection from old otorrhœa of childhood. The ear was, however, so sensitive to interference and the meatus so closed that the actual condition was not determinable at that time. The watch could not be heard in this ear. The tuning-fork was heard one third less when placed on mastoid.

January 11 she felt much better. Dr. Jackson produced no movement by pressing as before, but she could by putting her finger in her ear produce movements of very slight excursion. The discharge from the ear was almost gone. The remedies used were syringing of the ear, and quinine in doses of from two to three grains.

February 27 patient felt perfectly well and had gone back to her professional duties.

With regard to this case, Dr. Jackson says it is needless to do more than mention the now old, but very important experiments of Flourens on the semi-circular canals. This case, like that recorded by Schwabach illustrates very well Cyon's experiments on the semi-circular canals of rabbits. Dr. Jackson supposes that in his patient the pressure made on the tragus was transmitted by the chain of bones to the contents of the semi-circular canals; probably the contents of one or more of these canals was abnormal also. To reach the ocular muscles there must have been a propagation of the changes from the canals, through some part of the nervous system, cerebrum or cerebellum or possibly through both.

Bürckner's case (*Archiv für Ohrenheilkunde*, Bd. XXVII., p. 185) occurred in a girl 20 years of age. Chronic purulent inflammation of the middle ear, right

side. Nystagmus of both eyes followed invariably the introduction of a speculum and syringing of the ear. A careful examination made subsequently showed that even the effort to hear with this ear brought on nystagmus. The patient herself was not aware of the oscillations of the eyeballs. The ophthalmoscopic examination showed normal condition of the eyes.

E. Pflüger (*Deutsche Zeitschrift für practische Medicin*, 1878, No. 35,) has reported a case of chronic purulent otitis media, with formation of polypi on the upper wall of the external auditory canal, very near the drumhead, in which horizontal oscillatory movements of the eyeballs occurred whenever the polypi were touched. He attributes the nystagmus to cerebral irritation.

With regard to the cause of the nystagmus in my own cases I have no other explanation to offer than that given by Schwabach and Jackson.

EXPERIMENTS ON THE SEMI-CIRCULAR CANALS OF THE LOWER ANIMALS.

In a memoir presented to the Académie des Sciences in 1877 (*Les organes Peripheriques du Sens de l'Espan. Comptes-Rendus* 1877) Cyon described a series of ocular movements and oscillations which he observed on mechanical irritation of the semi-circular canals in rabbits. The great feature of these ocular movements was that the direction was determined by the canal irritated. Each semi-circular canal has a special influence on the ocular movements. Excitation of the horizontal canal in the rabbit produces a rotation of the eye on the same side in such a manner that the pupil becomes directed backwards and downwards. Excitation of the posterior vertical canal causes a deviation of the eye so that the pupil looks forwards and slightly upwards; while irritation of the superior vertical canal causes a deviation backwards and downwards.

The excitation of each canal always causes movements of both eyes, but the movements of the opposite side are contrary to those of the side irritated. The pupil contracts on the side irritated and becomes dilated on the opposite.

Cyon, however, in his thesis *Sur les Fonctions des Canaux Semicirculaires*, 1878, makes some modification of his statements as to the direction of the ocular movements, particularly as regards those depending on irritation of the horizontal and posterior vertical canals. Irritation of the horizontal canal, he says, causes the globe to be directed forwards and downwards; of the posterior vertical canal, backwards and upwards; and of the superior vertical canal, backwards and downwards. In the other eye the direction is contrary, viz.: backwards and upwards, forwards and downwards, and forwards and upwards, on irritation of the horizontal, posterior, and superior vertical canals, respectively. This discrepancy is doubtless due to the fact that the nystagmus which comes on after the first deviation, which is almost tetanic in character, is apt to mix itself up with the direct effects of irritation and to reverse the really primary movements. The result first obtained by Cyon seems to me more in accordance with other facts than the latter ones. (Ferrier, *Functions of the Brain*, 2d Edition, page 210.)

The results obtained by Cyon were supplemented and in part confirmed by the experiments of Högyes (*Ueber die wahren Ursachen der Schwindelserscheinungen bei der Drucksteigerung in der Paukenhöhle*. *Pflüger's Archiv für Physiologie*, Bd. XXVI., p. 588). This author, on the strength of his experiments, expresses the opinion that the vestibular terminations of the acoustic nerve are a peculiar terminal apparatus which regulates the movements of the eyes and probably the movements of all the muscles subservient to the maintenance of equilibrium, according to the position of the head or the body. For our purpose an

experiment on a rabbit is particularly interesting, in which the perilymphatic liquid was sucked out with a glass tube and air gently blown through the same tube into the perilymphatic space; whereupon bilateral movements of the eye and on more forcible blowing marked nystagmus followed. (Moos, Archives of Otology, Vol. XII., p. 313.)

